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From Box 8-3-35

May 4, 1978
M. E. Mullins

TECHNETIUM AND THE ENVIRONMENT

With the introduction of technetium into the diffusion cascade in the early 1950's, and the ~~corresponding~~ lack of recognition ~~even~~ of technetium as a potential environmental problem, it was inevitable that eventually a ~~good deal~~ some of this element should find its way into the air, water and soil surrounding ORGDP. Environmental monitoring for technetium in the liquid and gaseous effluents from ORGDP dates only from 1974. Therefore, it cannot be accurately determined when the release of Tc-99 began and when the rate of release reached a steady state. Therefore, the total amounts of technetium released to the environment are unknown. Presently, concentrations of technetium in the air, soil, sediments, and water are being well documented. More recently, the effects of Tc-99 uptake in vegetation close to ORGDP have been studied. It is clear from these initial tests that much more complete data must be collected in this investigation before the long term environmental effects ~~maybe~~ can be assessed.

The release of technetium to the ORGDP area has occurred chiefly at two sources: to the air from the vent gas stack in the purge cascade facility, and to the waters of Poplar Creek from the rinse water of the K-1420 uranium decontamination and recovery facility. The releases to the air also resulted in the deposition of Tc-99 on the soil and vegetation surrounding the plant. The consequent rain water runoff constitutes another source of technetium to the waters of Poplar Creek and the Clinch River. In addition to the effluent streams located at ORGDP, raffinate solution from the K-1420 facility was shipped to Y-12 during 1977 for treatment in their biodenitrification facility.

There was an additional 8.85ci of Tc-99 contained in this raffinate solution, which after treatment was deposited in an acidic retention pond. Consequently, trace levels of technetium exists in nearly every water body near the ORGDP both upstream and downstream of the plant; the soils and sediments of the area do contain trace amounts of Tc-99; and the ambient air contains small amounts of Tc-99.

The number of studies which have been conducted on the potential toxicity, biological uptake, and accumulation of technetium in the environment are very few and the results of these studies are generally inconclusive. Studies on deposition of Tc-99 in soils and subsoils have been conducted by the Batelle Northwest Laboratories (1). Also for many years East Texas State University has conducted tests for trace background amounts of Tc-99 in rain water and air (2). These tests seem to indicate that Tc is rather pervasive in its distribution in the air throughout the U.S.. There have been two principle sources of this free technetium. First, the explosion of ~~thermonuclear~~ nuclear devices ~~converts molydenum in the weapon casing into technetium, thus contaminating~~ produces Tc 99, thus contaminating the atmosphere. Also, the reprocessing of spent reactor fuels tends to result in the release of this fission product from gaseous diffusion plants. Once again total amounts of free Tc-99 are unknown. The effects of this free Tc-99 upon vegetation, animals, and man have been subject to limited study. In the literature surveyed, cummulation factors from soil-to-plants range from .25 to 700 (Ci/kg wet tissue per Ci/kg dry soil). Comparing known corresponding soil and grass samples taken from around the ORGDP area, the coefficient would seem to be in the range of 2 to 5. This soil and plant accumulation is most likely to be in the form of the pertechnetate ion (TcO_4^-) the least soluble

of the Tc-99 species. Technetium concentrations on the order of .01μCi/g soil have been shown to be chemically toxic to some plants. Ref. However, no general threshold of toxicity has been determined. The degree of uptake and accumulation of Tc-99 by animals and men through the food chain is subject only to speculation. Till, Hoffman, and Dunning (3) have done 50 year calculations for Tc-99 in adult humans. However, their calculations are based upon an accumulation factor of 50. There is no experimental data to support this at this time. The radiological and toxilogical effects upon animal life are unknown. Oak Ridge National Laboratory has also conducted a study to determine the effect of technetium on aquatic life (4). However, it cannot at this time be determined whether the levels of Tc-99 (See Figure 1) in the water and sediments of Poplar Creek and the Clinch River pose any threat to aquatic plants or animals.

Not so! this type of gratuitous statement must be omitted from reports!! No.

Although several vegetation uptake studies have been conducted, they are limited to hot house studies of plants growing in soil spiked with Tc-99. Therefore, rainwater runoff of Tc-99 and other weathering factors have not been considered in the experiments. Samples taken from around the ORGDP area with known soil concentrations of Tc-99 show uptake levels up to only about 35 ρ Ci/of dry weight (See Figure 2) or an accumulation coefficient of about 2 to 5. At these levels, we feel that Tc-99 does not represent an immediate hazard to human or animal life.

What is limit

Current concentrations of Tc-99 in the air around K-25 are near or below the limits of detection. The highest level detected is approximately .35 dpm/m^3 at the perimeter fence. Since the addition of the new KOH Purge Cascade vent gas scrubber and the switch to newer equipment

decrease, the level of Tc-99 in the

in the K-402-9 purge cascade, gaseous emissions from this source has decreased significantly during 1977 (See Figure 3). As a consequence, levels of Tc-99 in effluent streams which catch rainwater runoff should see a steady decline over the next several years. (Points 1 & 4, Fig.3) As CIP/CUP activities at ORGDP decrease, the level of Tc-99 in the liquid effluent from the K-1420 Uranium Decontamination and Recovery Facility should decrease proportionally. Also, Tc-99 removal systems for the liquid effluent of the decontamination facility are being considered.

How do you define significant?

In addition to the Tc-99 discharged to the air and water, there are three onsite disposal areas which retain signigicant amounts of Tc-99. As seen in Figure 4, these are: the K-1407-B holding pond, the K-1407-C Retention Basin, and K-722 scrap metal yard. The K-1407-B holding pond is primarily a solids settling basin for the liquid effluent from the K-1420 facility. Based upon sediment samples from this pond, it is estimated to contain about 4.5 Ci of Tc-99 chiefly in the form of TcO_4^- bound to the sediment. Similar sediment was removed from this pond in 1974 and placed in the K-1407-C retention basin. Approximately 12.56 Ci of Tc-99 now resides in that pond. The third storage area containing significant quantities of Tc-99 is the K-722 scrap metal yard. This area consists of several (?) acres of contaminated scrap metal containing an undetermined quantity of Tc-99. Due to the nature of the scrap, it is very difficult to estimate possible Tc-99 levels. However, samples of the rainwater runoff from the storm sewer system shows Tc-99 in the range of .5-.8 Ci/year flowing into the Clinch River from the scrap metal yard.

also include grams

15 to 24 g

The total amounts of technetium released from 1975 to 1977 are tabulated in Figure 4. At all of the effluents listed, concentrations are well below the guidelines set in ERDA Appendix 0524, Annex A, Standards for Radiation Protection of $3X10^{-4}$ pCi/ml for water and $7X10^{-8}$ pCi/ml for air.

Currently, there are no EPA or Tennessee state guidelines for total amounts or concentrations of Tc-99 or total beta-activity in effluent streams; air or water. At the sites of the other diffusions plants in Ohio and Kentucky, the individual states have set limits on the amounts of total beta-activity in the effluents. It is quite possible that the state of Tennessee will set such limits in the future. However, by that time CIP/CUP activities at ORGDP should be over and the levels of Tc-99 in our effluents should have decreased significantly.

In the intervening years however, it is important to investigate the various technologies available for Tc-99 removal in our liquid effluents, and possible applications in the decontamination facility, K-1420. In light of the increasing awareness of Tc-99 in the environment, governmental regulation is quite possible. Even though, it is obvious from reviewing the literature that the possible environmental effects are not known at present. To prepare ORGDP for such legislation, records are now being kept on the total Tc-99 lost to the environment, environmental samples are being taken, and a continuing effort will be made to collect relevant data and assess the impact of Tc-99 upon the animal and plant life of the area.

TABLE 3

ORGDP EFFLUENT STREAMS TECHNETIUM DATA SUMMARY

Put Stds in this table so reader won't have to flip pages.

Ci/Yr. DISCHARGED

		1975	1976	1977	ORIGIN
1	K-1407B	4.44	19.80	10.30	K-1420 Uranium Decontamination Facility
2	K-1203	0.49	0.36	1.04	Rainwater Runoff
3	K-1007B	1.70	3.26	3.33	Rainwater Runoff
4	K-901-A	2.40	0.65	0.37	Rainwater Runoff
5	K-311-1	0.30	6.79	1×10^{-6}	Purge Cascade Vent
6	K-402-9	----	----	1×10^{-6}	Purge Cascade Vent
	TOTAL	9.33	30.86	15.04	